

A NEW CORNUTE CARPOID FROM THE UPPER CAMBRIAN (IDAMEAN) OF QUEENSLAND

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Smith, A.B. & Jell, P.A. 1999 06 30: A new cornute carpod from the Upper Cambrian (Idamean) of Queensland. *Memoirs of the Queensland Museum* 43(1): 341-350. Brisbane. ISSN 0079-8835.

The first Cambrian carpod from Australia, *Drepanocarpus australis* gen. et sp. nov. is described from the Chatsworth Limestone in the Lily Creek section at Chatsworth 100km north of Boulia, western Queensland. Its age is the *Peichiashania secunda* - *Prochuangia glabella* Zone, latest Idamean Stage (=mid Franeonian Stage), in the medial Late Cambrian. It belongs to the cornute Family Phyllocystidae, having cothurnopores, rigidly plated dorsal surface and flexible plated ventral surface, a well-defined marginal frame with ventral vertical strut and dorsal transverse strut and 6 well-defined rings in the proximal part of tail. □ *Carpoid*, *Phyllocystidae*, *Upper Cambrian*, *Queensland*.

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Carpoids are rare in Upper Cambrian rocks. Ubaghs (1963) described one from a unique specimen and two others from fragmentary material of uncertain generic placement; all 3 came from a single locality and horizon in the early Trempealeuan Whipple Cave Formation in Nevada. Sumrall et al. (1997) featured 6 carpooids from the Upper Cambrian of Wyoming and Nevada with none of them represented by a complete specimen and all known from 1 or 2 specimens or a single slab; the 3 cornutes are assigned specific names in 2 new genera, *Acuticarpus* and *Archaeocothurms*, the other 3 taxa are left in open nomenclature. Ubaghs (1999) described a new genus, *Lobocarpus*, from the Upper Cambrian of Montagne Noire, southern France. Known Australian carpooids are reported elsewhere in this Memoir (Ruta & Jell, 1999a-e) and derive from the latest Ordovician to Early Devonian clastic sequences of Victoria and Tasmania. However, the Cambrian and great majority of the Ordovician in Australia have yielded no carpooids, and cornutes have never been recorded from Australia.

At Museum of Victoria Locality NMVPL1597 (= Bureau of Mineral Resources Locality K204 of Shergold, 1982) in a 4m thick grey micaceous limestone forming a bench on the low limestone rise 3.5km S of Chatsworth Homestead 60km SW of Duchess, W Queensland is a rich silicified fauna of trilobites (*Connagnostus* sp. undet., *Iveria iverensis*, *Lorretina depressa*, *Peichiashania secunda*, *Prochuangia glabella*,

Pseudagnostus parvus, *Pseudagnostus* sp. undet.), gastropods, monoplacophorans, brachiopods, hyoliths, sponges and echinoderms. The last mentioned group was partly described by Jell et al. (1985) who treated the 'eocrinoid' *Riddersia watsonae* and noted an isorophid edriasteroid and by Smith & Jell (1990) who described the isorophids *Hadrodiscus parma* and *Chatsworthia spinosa* (=isorophid of Jell et al. 1985) and the edriblastoid *Cambroblastus enbilatus*. Details of the location are available in Shergold (1982, figs 3,4) who also dated the bed, based on trilobites, as within his *Peichiashania secunda* - *Prochuangia glabella* Zone, the youngest within the Idamean Stage.

The fossils are coarse silica replacements of extremely fine structures and in no specimen is replacement complete. Unravelling the structure of the species has been achieved by gathering some information from each of 12 available specimens and piecing it together into a picture of the whole animal. This approach necessitates more illustrations and camera lucida drawings than is normal to understand the species.

Illustrated material is deposited in the Queensland Museum, Brisbane (QMF) and the Natural History Museum, London (BMNH). Plate lettering, orientation and terminology follow Jeffries et al. (1987) without necessarily entering the debate on the affinities and possible biology of carpooids.

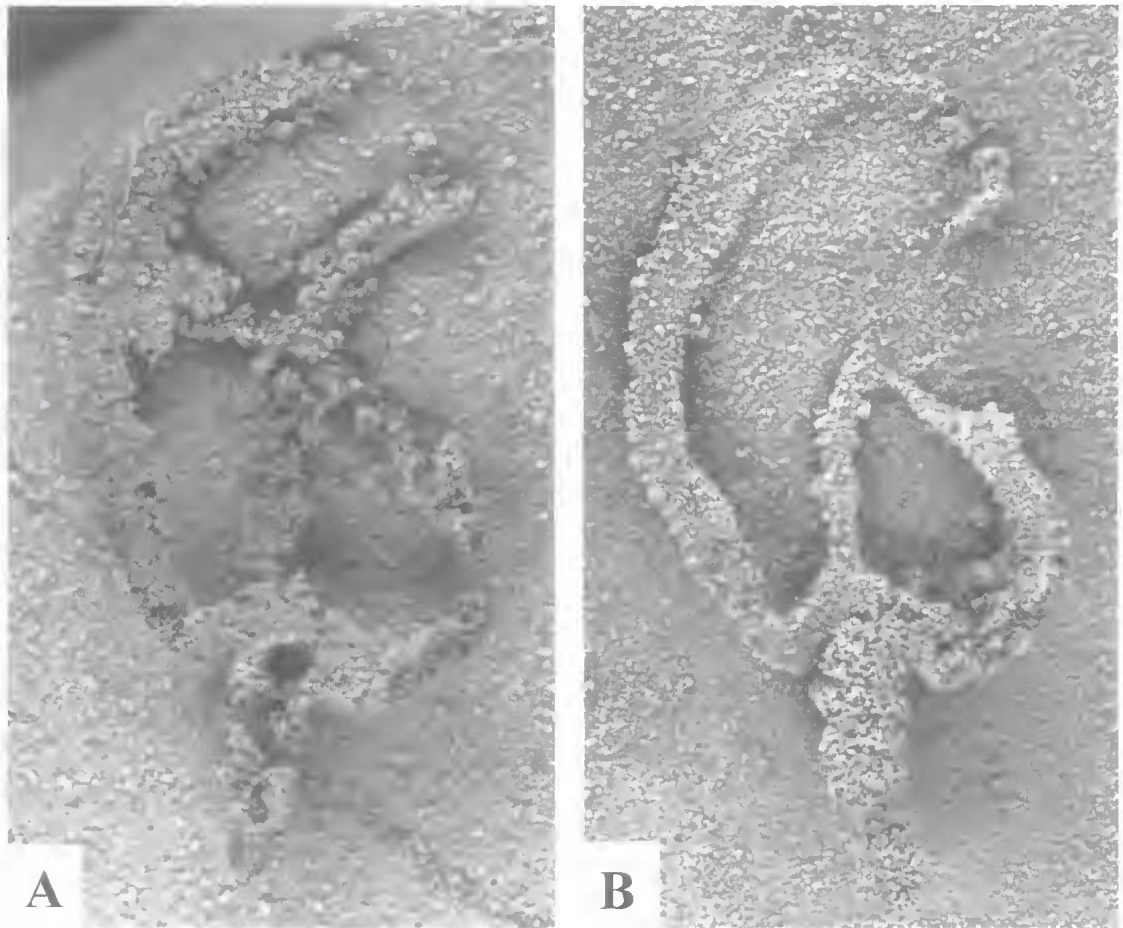


FIG 1. *Drepanocarpus australis* gen. et sp. nov., ventral surface uppermost, $\times 9$. A, QMF17862. B, QMF17860.

SYSTEMATIC PALAEOLOGY

Order CORNUTA Jaekel, 1901
 Family ?PHYLLOCYSTIDAE Derstler, 1979
***Drepanocarpus* gen. nov.**

TYPE SPECIES. *Drepanocarpus australis* sp. nov.

ETYMOLOGY. Greek *drepanon*, a sickle or blade, alluding to the curved marginal frame, and *carpos*, a fruit—the common name applied to this group.

RANGE AND DISTRIBUTION. Upper Cambrian (Idamean = Franconian) of Queensland.

DIAGNOSIS. Cornute with body longer than wide, with strong marginal frame and ventral strut; ventral surface composed of a few large plates; dorsal tegmen of many small platelets. Gill slits 4-5, as cothurnopores in the posterior left-hand side in an embayment of marginal plate

k, framed by skeletal elements. A transverse bar on the dorsal surface separates the body into proximal and distal portions. Proximal part of appendage with 6 well-defined rings, distal part narrower. No strongly differentiated stylocone.

REMARKS. This genus belongs to the Cornuta on account of its marginal frame and distinctive bipartite appendage. Of the 3 families currently recognised, Scotiacystidae has a very distinctive gill slit morphology quite different from that in *Drepanocarpus* and thus need not be considered further.

The elongate body form, tessellated dorsal plating and finer platelets of the ventral surface are typical of phyllocystids such as *Lobocarpus* Ubachs, 1999, the only named phyllocystid

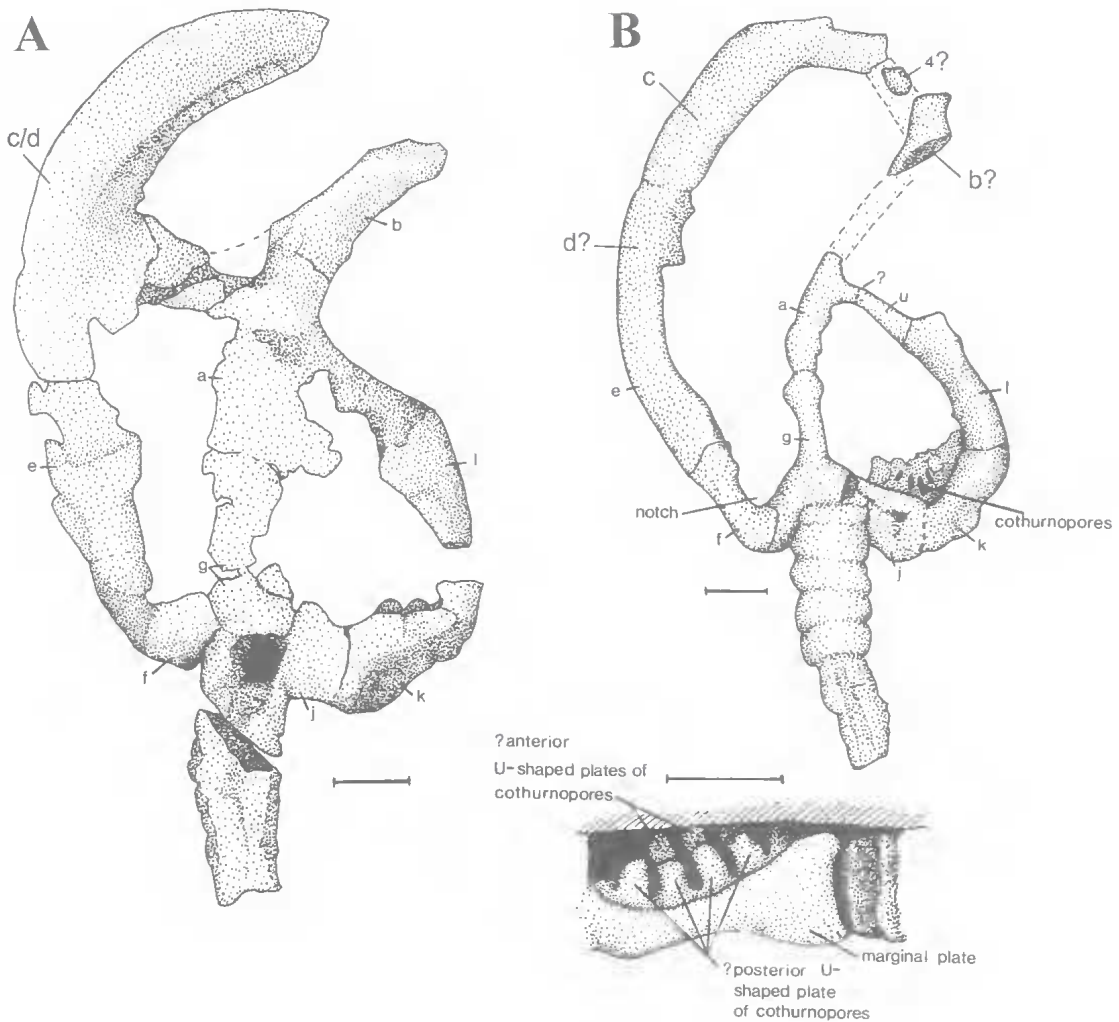


FIG. 2. *Drepanocarpus australis* gen. et sp. nov., camera lucida drawings of ventral surface with plating interpretation (plate lettering follows the system of Jefferies et al., 1987). A, QMF17862. B, QMF17860. C, posterior view of the left hand side of QMF17860, dorsal surface uppermost. Cross hatching = sediment. Scale bar = 1mm.

known from the Cambrian. Note that Ubaghs was equivocal in his family assignment.

Lobocarpus differs from *Drepanocarpus* in having a much more heart-shaped body, with broad, flange-like marginals and a less well-developed central strut. *Drepanocarpus* differs from the type species of *Phyllocystis* in having a more asymmetric body, deeper left marginal indentation and in having larger and fewer dorsal plates.

With the uncertainty of classification among the early Palaeozoic cornutes some comparisons with ceratocystid and cothurnocystid Cambrian forms are warranted.

Drepanocarpus resembles Middle Cambrian *Ceratocystis* Jaekel, 1901 from Europe in its overall shape, although the body is more rounded proximally. The ventral surface is composed of a small number of large sutured plates, these probably being extensions of the marginal plates.

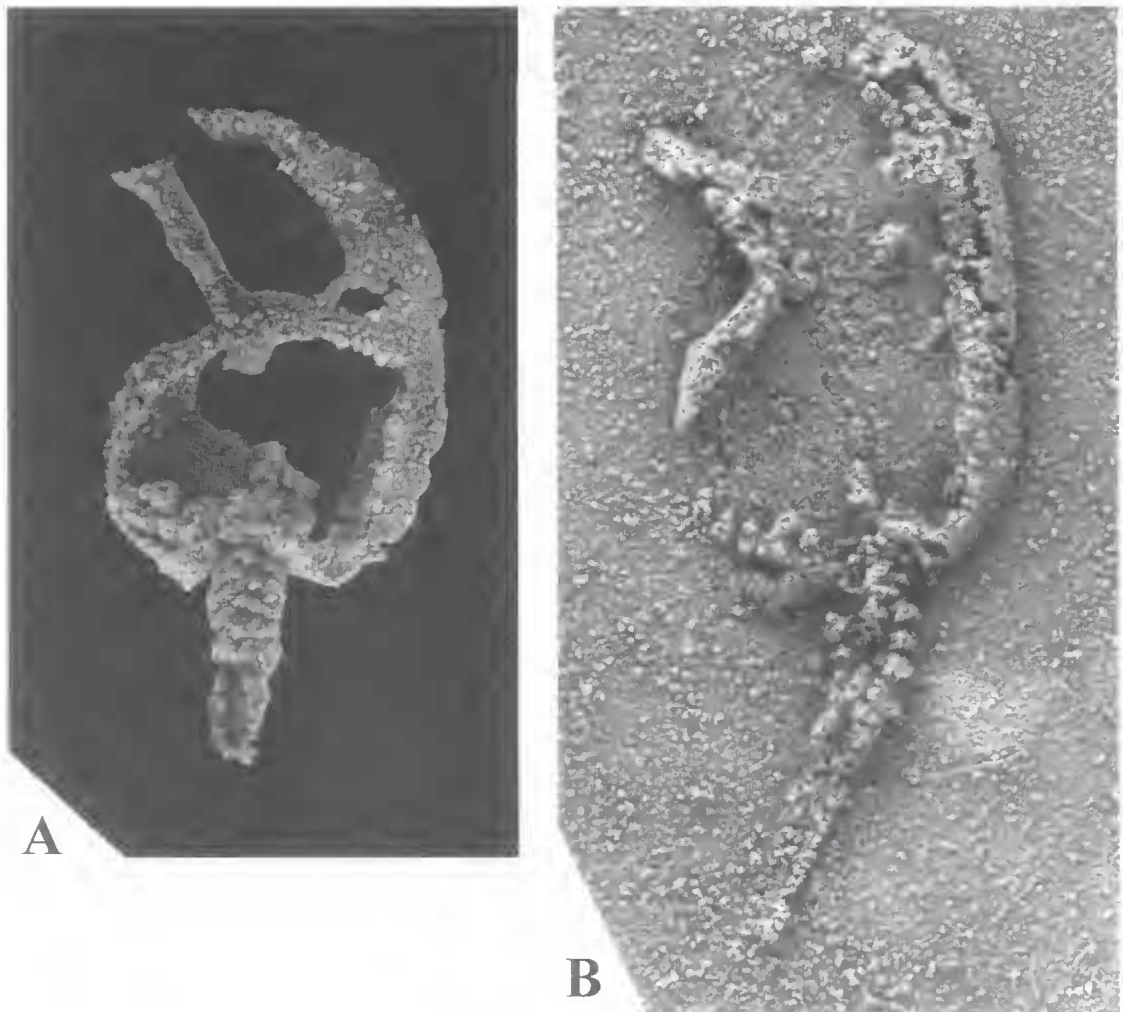


FIG. 3. *Drepanocarpus australis* gen. et sp. nov., dorsal surface uppermost, $\times 9$. A, QMF17861. B, BMNH EE6344.

Drepanocarpus differs from *Ceratocystis*, however, in a number of important details. Most importantly its gill slits are not in the form of sutural pores but rather cothurnopores.

Protocystites meneviensis from the Middle Cambrian of Wales (Jefferies *et al.*, 1987) closely resembles *Ceratocystis* in shape but has reduced ventral plating and a better defined proximal tail, like *Drepanocarpus*. It differs from *Drepanocarpus* in the absence of a sagittal strut on the interior of plates a and g and the very different shape and arrangement of the distal spines and gill slits, which resemble those of *Ceratocystis*.

'*Phyllocystis* sp.' and *Nevadaecystis americana* Ubaghs from the latest Cambrian of Nevada (Ubaghs, 1963). *Cothurnocystis? bifida* Ubaghs & Robison from the Middle Cambrian of Utah (Ubaghs & Robison, 1988) and an unnamed cothurnocystid from the Middle Cambrian Spence Shale of Utah, U.S.A. (Sprinkle, 1976) have cothurnopores (oval spout-like openings within the dorsal tegmen) and well-defined rings in the proximal part of the tail. *Cothurnocystis? bifida* is more L-shaped in outline than *Drepanocarpus* and plate l forms the distal left-hand angle of the head carrying a very large process. It also has a ventral tegmen of retiform

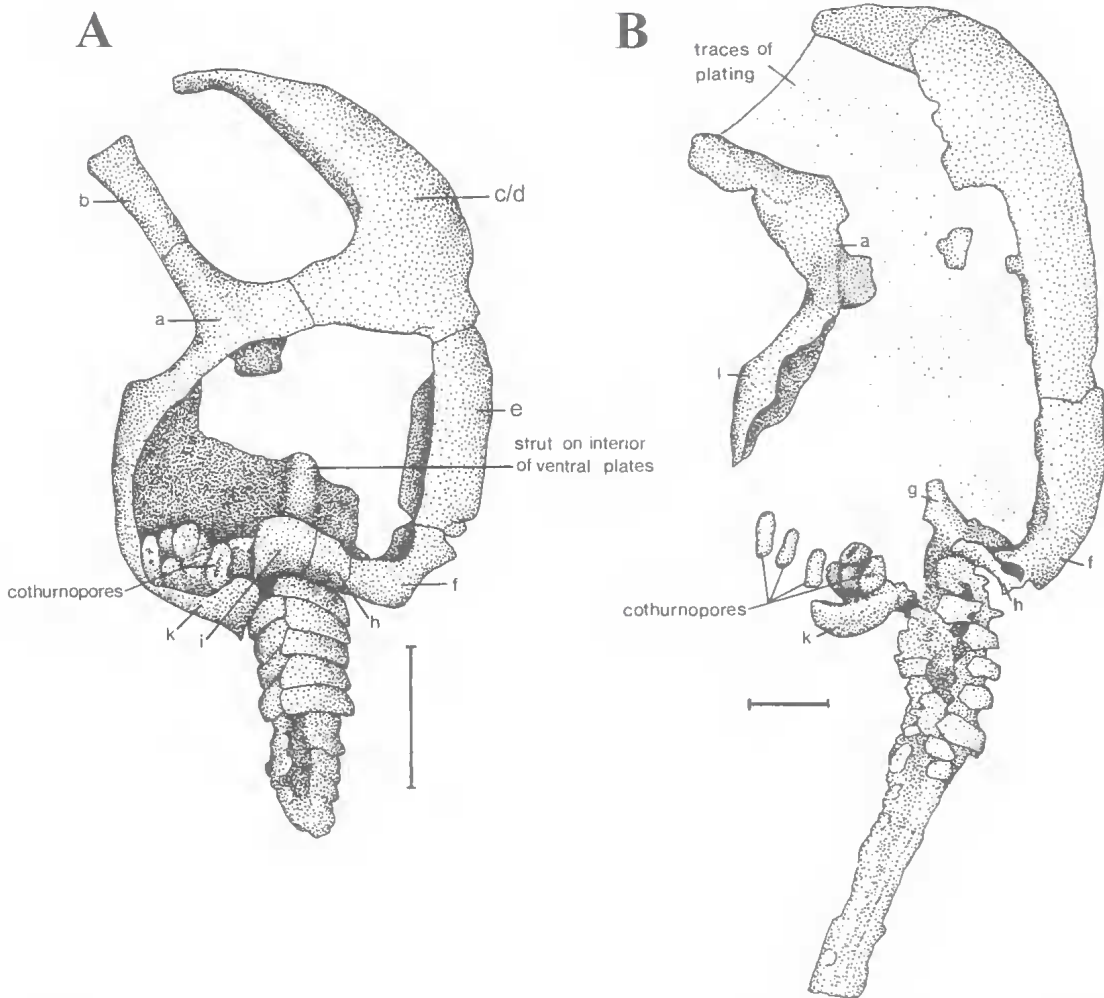


FIG. 4. *Drepanocarpus australis* gen. et sp. nov., camera lucida drawings of dorsal surface with plating interpretation (plate lettering follows the system of Jefferies et al., 1987). A, QMF17861. B, BMNH EE7344. Scale bar = 1mm.

stereom, possibly in the form of a continuous sheet of calcified integument. Unlike *Drepanocarpus* plates a and e are not united by a transverse bar, although this may be a result of poor preservation.

Nevadaecystis is laterally elongate and shaped like *Cothurnocystis*, with similar highly developed lateral blade-like processes on plate 1. Also, like *Cothurnocystis* but unlike *Drepanocarpus*, plates a and e in *Nevadaecystis* are unconnected and the distal border of the buccal cavity lacks plate 4. Like *Drepanocarpus* it has a ventral surface of large plates, extensions of the marginals, and a dorsal tegmen of much smaller

platelets. There is also a saggital strut formed presumably from the internal thickening of two of these plates. Jefferies et al. (1987, fig. 12) interpreted *Nevadaecystis* as having an additional plate x, like *Cothurnocystis fellensis*. However, in the reconstruction of Ubaghs & Robison (1988, fig. 11.1) no such plate is shown.

The unnamed cornute from the Middle Cambrian Spence Shale in Utah (Sprinkle, 1976) resembles *Drepanocarpus* in shape and plating arrangement, in lacking obvious appendages to the marginal frame, in having a dorsal tegmen of small platelets, in having a smoothly rounded right margin and in having cothurnopores across

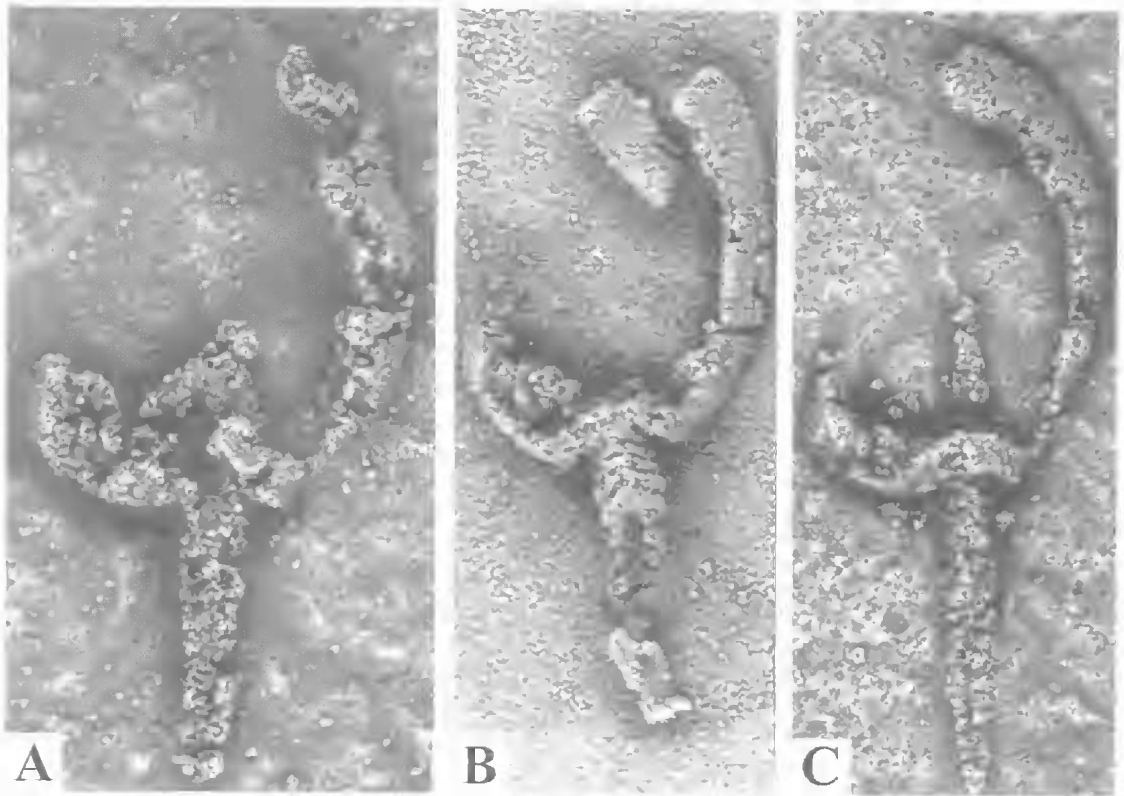


FIG. 5. *Drepanocarpus australis* gen. et sp. nov., dorsal views showing cothurnopores. A, QMF17866, $\times 11$. B, QMF17863, $\times 8$. C, BMNH EE6345, $\times 8$.

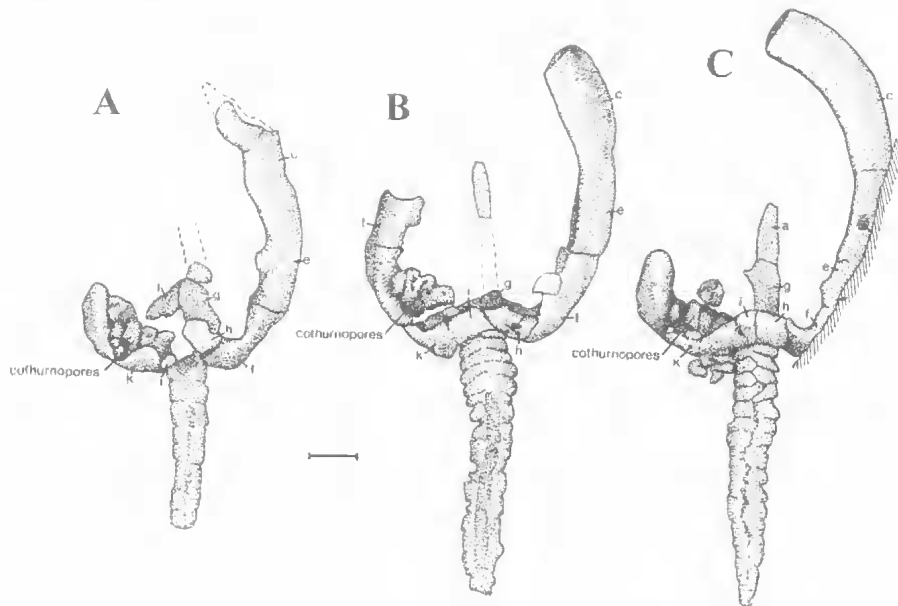


FIG. 6. *Drepanocarpus australis* gen. et sp. nov., camera lucida drawings of specimens in dorsal view showing cothurnopores. A, QMF17866. B, QMF17863. C, BMNH EE6345. Scale bar = 1 mm.

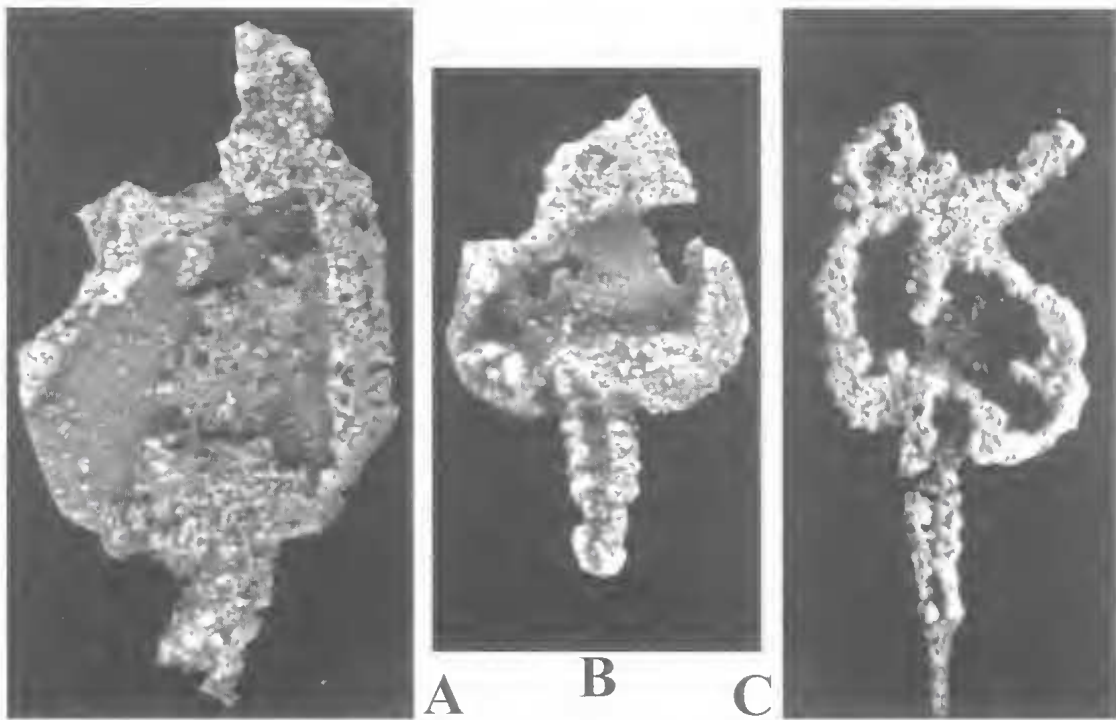


FIG 7. *Drepanocarpus australis* gen. et sp. nov. A, QMF17867 in dorsal aspect, $\times 10$. B, QMF17865 in dorsal aspect showing fully plated ventral surface, $\times 10$. C, BMNH EE6346, in ventral view, $\times 12$.

the posterior edge running between plates l and k. Unfortunately the ventral plating is unknown and we do not know whether plates a and e are united to form a transverse bar behind the buccal area as in *Drepanocarpus*.

Archaeocothurnus Sumrall et al., 1997 from the Middle and Upper Cambrian of Utah and Nevada, and including '*Phyllocystis*' (Ubaghs, 1963), differs from *Drepanocarpus* in that plate g is reduced to a narrow strut and there is a plated dorsal tegmen. This genus is thus more closely comparable to *Cothurnocystis*.

Acuticarpus Sumrall et al. (1997) from the Upper Cambrian of Wyoming is distinguished by its triangular shape, the more slender marginal plates, presence of a stylocone and lack of spines along the thecal margin. Poor understanding of the anterior of the theca makes comparison more difficult.

There are some similarities, indicating affinity, between *Drepanocarpus* and *Hanusia* Cripps, 1989 from the Ordovician of Czechoslovakia, particularly in possession of the spike on plate l. However, that genus has an l-spike and an

e-spike, very limited extension of marginals onto the ventral surface, virtually straight right thecal margin, elongate thecal shape, and probable cothurnopores on dorsal surface.

In summary *Drepanocarpus* appears to be distinct from Ceratocystidae and Cothurnocystidae and bears most resemblance to the Phyllocystidae in particular *Lobocarpus* and Sprinkle's (1976) Spence Shale stylophoran. We thus make tentative assignment to the Phyllocystidae in line with Ubaghs (1999) caution in assigning *Lobocarpus*.

***Drepanocarpus australis* sp. nov.**
(Figs 1-9)

ETYMOLOGY. Latin *australis*, southern, the only cornute so far known from Australia.

MATERIAL. Holotype, QMF17860, paratypes QMF17861-17871 and BMNH EE6344-6346.

DIAGNOSIS. As for genus.

DESCRIPTION. Body up to 10mm long and 7mm wide. Appendage more than 10mm long in an individual with a 5.5mm long body (Figs 8C,

10A) generally shorter, abruptly truncated. Ventral surface flat, with left laterodistal margin deeply embayed at plate a, with right margin uniformly convex. Proximal margin slightly embayed close to the appendage.

The appearance of individuals varies with the extent of weathering. In better preserved specimens distal plates b and c appear as curved processes resembling appendages (Figs 1A, 2A, 3, 4), while in the holotype these 2 processes are connected distally, forming a continuous marginal frame (Figs 1B, 2B). Marginal frame of 7 plates possibly, with 2 dorsal and 2 ventral plates above and below the tail. Plate k embayed dorsally for cothurnopores; cothurnopores as narrow slits surrounded by plating (Figs 4, 5) or as deep notches (Fig. 2), partially underlain by a narrow ledge. Plate l with a short pointed spike not much longer than the thickness of the marginal frame. Plate boundaries on the marginal frame are very difficult to make out, especially anteriorly because of the coarseness of silicification and because the anterior is available in only 2 specimens. Plates a and c/d apparently abutting to form a transverse strut across the body. Plate c/d (these 2 plates are inferred but no separating suture can be discerned with certainty) long and curved, tapering distally, with short lateral bar distally; one specimen (Fig. 1B) suggests that a short lateral bar connects to plate b across the distal extremity of the body via a small plate. We do stress that this interpretation of a single specimen requires verification. Distal processes not present. Plates c/d, e and f forming a continuous smooth curved right-hand margin. Plate f with an internal notch proximally.

Dorsal plating best seen from the interior. Suture separating plates a and g evident; suture defining a V-shaped region towards the right. Other sutures not discernible; dorsal surface of a few large plates sutured together but the precise pattern of plate sutures is unknown. No large calcite plates are preserved distal to the transverse bar formed by plates a/c.

Ventral surface largely lost; small plates occasionally seen inside marginal frame may be the remains of a plated tegmen.

Cothurnopores 4 or 5, in the proximal angle of the head close to the marginal frame in the embayment of plate k (Figs 5, 6). Fine structure masked by preservation, apparently a row of closely spaced oval mounds, each with an irregular surface sometimes showing a median depression.

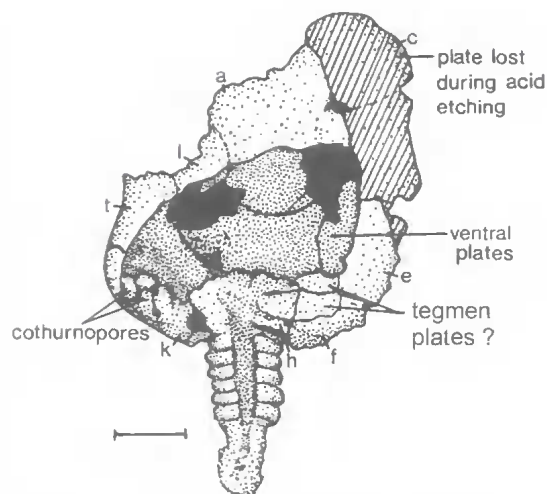


FIG. 8. *Drepanocarpus australis* gen. et sp. nov., camera lucida drawings of QMF17865 with plating interpretation. A, dorsal view. B, proximal view. Scale bar = 1mm.

Appendage of a thicker proximal part of 6 well-defined rings and a thinner distal part (whose structure is not well seen in any specimen). No specimen well enough preserved to show the stylocone.

REMARKS. Although 12 specimens of this species are known, none is sufficiently well-preserved to show all of the characteristic features. The reconstruction (Fig. 9) has therefore had to be composite. In particular plate sutures are often difficult to identify due to the coarse silica replacement, and sutures are only indicated if they appear consistently in a number of specimens. The different extent of weathering also poses a problem of interpretation. However, enough is known about this species to show that it merits separation at generic level from other cornutes as discussed above under the generic heading.

The most closely related cothurnocystid is the unnamed solute from the Spence Shale, Utah (Sprinkle, 1976, pl. 1, fig. 1) which differs from *D. australis* in having a slightly broader head, no spike on plate l, a longer and better developed plate i and no apparent connection between plate a and c (though this may be a preservational artefact; the connection is not seen either in QMF17860). Furthermore, the Spence Shale cothurnocystid has a narrower, less blade-like right-hand margin.

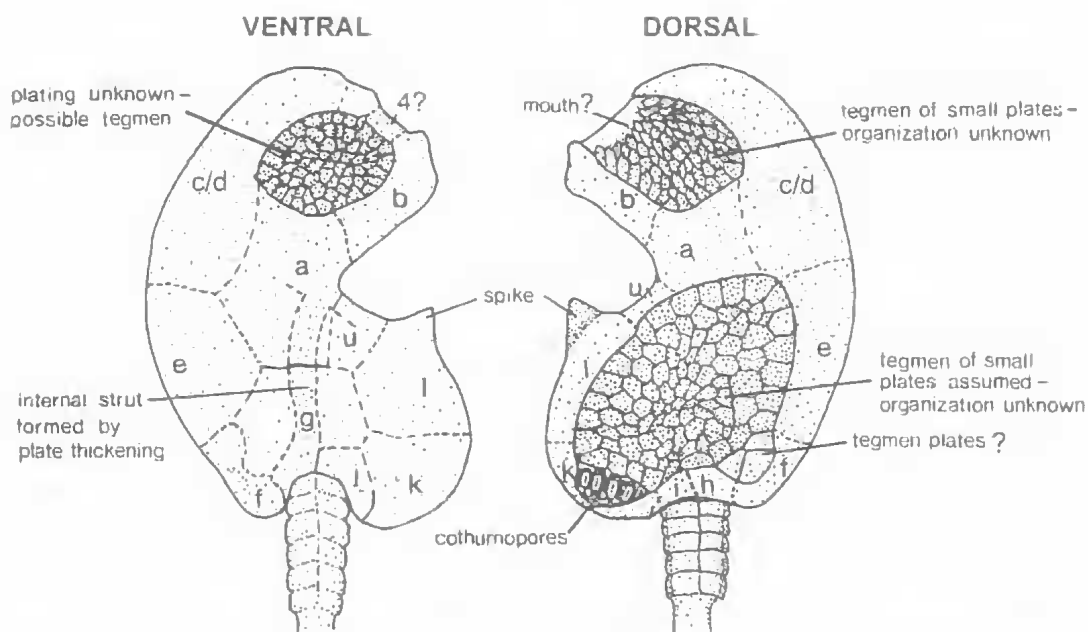


FIG. 9. Possible reconstruction of *Drepanocarpus australis* gen. et sp. nov. We stress that interplate sutures are not always clear and their representation with dashed lines indicates this uncertainty. The sketch is provided as the best estimate, though by no means certain, of the skeleton from available material.

ACKNOWLEDGEMENTS

We are grateful to Dick Jefferies, Natural History Museum, London and Jim Sprinkle, University of Texas, Austin for strong reviews, acknowledging that neither referee necessarily agrees with all or any of the conclusions.

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